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The effect of bow training on the endurance of the arm muscles of the beginner archery
El efecto del entrenamiento con arco sobre la resistencia de los músculos del brazo del tiro con arco principiante

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Abstract. This study aims to determine the effect of Bow Training exercises on the muscular endurance of beginner archery athletes in the Jambi City Kobar Club. The research carried out is an experimental study, which is conducted to find out presence or absence of increase from something imposed on the sample. This experimental study is carried out by the 10 people of beginner archery athlete in Kobar Club, with the details of the Pre-test, the test before doing the Bow Training and the Post-test, after doing the Bow Training. The overall results of the Pre-test points for endurance of the arm muscles by 113 points with an average endurance of the arm muscles of 11.30 points. While the overall results of points in the Post-test of endurance of the arm muscles by 151 points with an average endurance of the arm muscles of 15.10 points. Based on the results of this study it can be concluded that a person who is given Bow Training exercises will have arm muscle endurance exercises 3.8 points better than someone who is not given training. The results show that the hypothesis proposed is the existence of a significant effect of bow training exercises on increasing endurance of the arm muscles received with a 95% confidence level that can be seen from the results of the t-test that is t = 13.07684 greater than t table = 1.8331. So it can be conclude that the Bow Training exercises can increase endurance of the arm muscles by 11.237%. This means that there is a significant effect of Bow Training exercises on the endurance of the beginner's arm archery athletes in the Jambi City Kobar club.
Keywords: Bow training, muscular endurance, archery

Resumen. Este estudio tiene como objetivo determinar el efecto de los ejercicios de entrenamiento con arco en la resistencia muscular de los atletas principiantes de tiro con arco en el Club Kobar de la ciudad de Jambi. La investigación realizada es un estudio experimental, que se lleva a cabo para averiguar la presencia o ausencia de aumento de algo impuesto a la muestra. Este estudio experimental lo llevan a cabo las 10 personas de atletas principiantes de tiro con arco en el Club Kobar, con los detalles de la prueba previa, la prueba antes de hacer el entrenamiento con arco y la prueba posterior, después de hacer el entrenamiento con arco. Los resultados generales de la prueba previa apuntan a la resistencia de los músculos del brazo en 113 puntos con una resistencia media de los músculos del brazo de 11,30 puntos. Mientras que los resultados generales de la prueba posterior apuntan a la resistencia de los músculos del brazo en 151 puntos con una resistencia media de los músculos del brazo de 15,10 puntos. Con base en los resultados de este estudio, se puede concluir que una persona a la que se le dan ejercicios de entrenamiento con arco tendrá ejercicios de resistencia de los músculos del brazo 3,8 puntos mejor que alguien que no recibe entrenamiento. Los resultados muestran que la hipótesis propuesta es la existencia de un efecto significativo de los ejercicios de entrenamiento con arco en el aumento de la resistencia de los músculos del brazo recibido con un nivel de confianza del 95% que se puede ver a partir de los resultados de la prueba t que es t = 13.07684 mayor que la tabla t = 1.8331. Por lo que se puede concluir que los ejercicios de entrenamiento con arco pueden aumentar la resistencia de los músculos del brazo en un 11,237%. Esto significa que existe un efecto significativo de los ejercicios de entrenamiento con arco en la resistencia de los atletas de tiro con arco de brazo principiantes en el club Jambi City Kobar.
Palabras clave: Entrenamiento con arco, resistencia muscular, tiro con arco.

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Introduction

Sport is an activity that requires physical condition (Adji et al., 2022; Saifu et al., 2021; Salafi et al., 2022). Almost all sport, need a good physical condition (Amran et al., 2023; Salafi et al., 2023). Especially sports game, sports team, martial arts, and competition sports. It means, achievement in sports depend on quality of physical condition. "The better the physical condition, the greater the chance of achievement, so do otherwise." (Arifin et al., 2024; Shahril et al., 2024). Coaching and sports development is a conscious effort carried out systematically to achieve sports goals (Auliana et al., 2024; Sonjaya et al., 2024). This is appropriate with the System Law National Sports No. 3: 2005 article 4 on the basis, functions and objectives of sports, i.e.: "Sports aim to maintain and improve health and fitness, human quality achievement, instilling moral values of noble morals, sportively, discipline, strengthen and foster national unity and integrity, strengthen national defense and raise the nation's dignity and dignity and honor". Building sport achievements in our country requires a gradual coaching process and sustainable, both in the long term, medium term or short term (Dong et al., 2024; Sukendro et al., 2021; Sutapa et al., 2020). In

addition, it must be supported by trainers, coaches, adequate facilities and infrastructure, a good guidance system and must be supported by the required sports science and technology (Hardianto et al., 2022; Sutapa et al., 2021). In this millennium era, advances in science and technology have a very large role in efforts to improve achievements in various field countries in the world (Hastuti et al., 2021; Trisnadi et al., 2024; Trisnadi et al., 2023). Archery has been popular a long time ago, one of the Sunnah Rasul to teach our kids with one of sport that Our Prophet Muhammad SAW likes to do. In Indonesia, archery grows quickly and is introduced early on to children. This sport required full of smooth soul, patience, tenacity, concentrate, and high mental endurance and high anxiety.

Archery is a sport of accuracy, precision to be on target, because ultimate goal in archery is to shoot at the target's surface (Ilham et al., 2021). So, that one of the basic factors needed in archery movements is steady (consistency) that must be done continuously throughout the training and during the race. Archery is an activity using a bow for shot the arrow. This sport required special expertise and ability (Jufrianis et al., 2021; Utami et al., 2023). In Archery Championship, every archer has must be release the arrow right regarding the set targets (Kauki et al., 2024; Utami et al., 2024). Kogoya et al. (2023) said, "Archery is part of sport using a bow and arrow. In this sport, every player must be able to shot an arrow right at the target". The difference between archery and shooting lies in the type of strength it pushes. In shooting sport, the force of the impulse is obtained from the explosion of the instrument itself, whereas in archery the force of the impulse is very dependent on the energy or energy arising from the archer's pulls or stretch of the bow, where the energy obtained from the range is converted into thrust when the arrow is released. Therefore the use of these tools requires the strength and power of certain muscles, especially to pull the bow.

In Indonesia, a branch archery sports are divided into 4 divisions / rounds, namely recurve divisions, compound divisions, national divisions, and traditional divisions (Kristiyanto et al., 2020; Widodo et al., 2024; Yudanto et al., 2024). Each division has a different target face distance and size. Archery has a parent organization called PERPANI (Archery Association Indonesia). PERPANI in Jambi Province developed since in 1989. With the management of PERPANI Jambi, athletes who get achievement are increasingly develop.

Archery in Jambi City is currently in great demand both from the age of children, adults, to parents. This sport, does not determined the age limit, all can learn and participate in the race but either the class determined by the committee. Usually the race class is divided into 3. There is beginners, senior student and senior general. Various competitions often held in the Jambi City starts from the General Championship until the Junior/Student Championship. Jambi city often follows athletes to enter the Championship and even held selection because of the limited quota. But in terms of achievement, especially from beginner's athlete have not been optimal for the tournament or championship. It can be seen from the last tournament held in Jambi City that is Jambi Archery Series Championship at Persijam, beginner archery athletes have not been optimal for the achievement. It is because beginner athletes have not been good arm muscle endurance, so it affected the result of the arrow, whereas the dominant component in archery is in the arm muscle endurance. An archery race need a long time, archer must be release the arrow until 108 arrows. Usually, archery race start from 8 AM and could be done at 3 PM. The long time could be make the archer sometimes un-concentrate when release the arrow, because must hold the weight bow and does not have good arm muscle endurance. For good the shot of arrow result, archer requires some training to increase the achievement of the archer. With the special training and physical training to hold a bow (Bow Training) with the predetermined training program, beginner athlete expected have good arm muscle endurance. Hopefully, with a good arm muscle endurance could be increasing beginner athlete's skill when hold the bow and release the arrow at the right time.

This research conducted in the Archery field Kobar's Club, Jambi. This program will be given to beginner archery athletes in Kobar Club, where they usually exercise 3 times a week, in Tuesday, Thursday and Friday. In this club has not been any training program to increase their skill and to increase the optimal result of shot. To increase their skill, researcher required to give physical training to up their skill to hold the bow. The training program is called "Bow Training". Hopefully, this training can be increasing good accuracy arrows result for beginner athlete.

Bow training According to Listyarini et al. (2021) is an exercise by pulling a string / string on a bow, holding it when the pull is full with a good and correct position for at least 15 seconds and a maximum of 30 seconds. Then rest with double the time used, so for example you do bow training for 15 seconds, you need to rest for 30 seconds. Nasrulloh et al. (2021) says that Bow is a bow, Training is training. So Bow Training is an exercise using a bow the longer a person can pull and hold a bow with full pull continuously without any fatigue which means the higher the strength an athlete has when shooting. Nasrulloh et al. (2020) defines Bow Training in preparation for additional training for athletes to be able to maintain the consistency of archery movements by pulling the bow without using the arrows in full pull with the allotted time. Bow Training is a training system that uses a bow, the way to do bow training is almost the same as archery as usual but only pulls the bow by being held at full force. To get good endurance ability of the arm muscles cannot be separated from the elements of the exercises provided there are three aspects that need to be considered namely the technical aspects, physical aspects, and mental aspects.

Materials and Methods

This research is an experimental research because it is intended to see the effect of a treatment. As stated by Nasrulloh et al. (2022), Experimental research is a way to find a causal relationship between two factors that are intentionally caused by researchers by eliminating or reducing other factors that interfere. This research method is quasi-experimental. The design of this study uses one group of pre-test and post-test design. A group is given a treatment after the pre-test, then at the end of the treatment a final test (post-test) will be given. This study using push up for Pre-test and Post-test because to identify the effect of the treatment (Bow Training) to arm endurance.

The teste stands face to face in the test participant's hands which is located on the floor under both shoulders, elbows are kept or locked in a straightened arms, the whole body is straight, no body parts touch the floor except for both hands and heels, both feet are spread shoulder width apart. The counter stands behind or in front of the test participant, the test guide blows the whistle and turns on the stopwatch for 1 minute. The test taker takes the Push Up position by bending his arms, lowering his body until his chest almost touches the floor and pushing it back to the starting position, The body must be kept straight as long as it moves, Teste do the test as much as possible for 1 minute without having to stop. The value given is based on the number of repetitions performed correctly.

Population In this study use 10 athlete beginner archery in Kobar Club Jambi, 5 women and 5 man beginner athletes. The 10 athlete was in range of age 12-15 years old. That because this study will only treat beginner's athlete. This study uses total sampling, where all of people in population will be sampled. The normality test was used as data analysis technique data to determine whether the data has a normal distribution. Variant homogeneity test was used to test the variance of data in the experimental group. As for hypothesis testing, the Independent Sample t-test was used. The experiment is to test the hypothesis H1 as follows.

H1: there is a significant effect of Bow Training on the increase in arm muscle endurance beginner archery athlete Kobar Club Jambi City.

Results

The result of the measurement of arm muscle endurance in beginner archery athlete Kobar Club Jambi can be seen and summarized in the following table:

Table 1.
Measurement result of arm muscle endurance

	Avg	SD	Varian	Max. Score	Min. Score
Pre-test	11.30	11.79	3.4334	17	6
Pos-test	15.10	8.99	2.9981	20	11

Pre-Test

The Pre-test in this study carried out the endurance of the sample arm muscle doing Push Up, so that in this initial test there was no treatment for beginner archery athletes at the Jambi City Kobar Club. In this Pre-test it was found that the total value of arm muscle endurance in the Jambi City Kobar Club beginner archery athletes was 113 points, thus it can be averaged the arm muscle endurance in the Jambi City Kobar Club beginner archery athletes was 11.30 points then the test results early endurance of arm muscles can be categorized as less.

Table 2.
Percentage of Pre-Test of endurance of arm muscles

No	Man Grades	Women Grades	Category	Frequent		Percentage	
				Man	Wom	Man	Wom
1	> 30	> 24	Very Good	0	0	0	0
2	23 – 29	18 – 23	Good	0	0	0	0
3	16 – 22	12 – 17	Medium	1	2	10	20
4	9 – 15	6 – 11	Less	4	3	40	30
5	< 8	< 5	Very Less	0	0	0	0
Total				10		100%	

Based on the analysis of the data obtained in the pre-test of endurance of the arm muscles, there were 10 participants consisting of 5 men and 5 women. In the medium category there are 3 people with a percentage of 30%, in the category of lack there are 7 people with a percentage of 70%. The following is a graph of the percentage of the initial test of arm muscular endurance in the Kobar Club Jambi City.

Post-Test

The Post-test of this research is a test that is done after being given treatment or given training, so that the Post-test is a test after doing bow training on endurance of arm muscles. In this Post-test the total number of test results is 151 points. Therefore, the average endurance of the arm muscle is 15.10 Points, the final test results of the endurance of the arm muscle can also be categorized as Medium.

Table 3.
Percentage Post-test of Arm Muscle Endurance

No	Man Grades	Women Grades	Category	Frequent		Percentage	
				Man	Wom	Man	Wom
1	> 30	> 24	Very Good	0	0	0	0
2	23 – 29	18 – 23	Good	0	1	0	10
3	16 – 22	12 – 17	Medium	3	2	30	20
4	9 – 15	6 – 11	Less	2	2	20	20

5	< 8	< 5	Very Less	0	0	0	0
		Total			10	100%	

Based on the analysis of data obtained, in the Post-test of arm muscle endurance, the number of participants as many as 10 people divided into 5 men and 5 women in the good category. There is only 1 person with a percentage of 10%. Then, in the medium category, there are only 5 people with a percentage of 50%. Then, there are 4 people getting category of "less" with a percentage of 40%. The following is a graph of the percentage of the final test of endurance of the arm muscles.

Based on the results of arm muscle endurance in the beginner archery athletes of the Kobar Club, in the Pre-test amounted to 113 points, compared to the results of the Post-test of arm muscle endurance in the beginner archery athletes of Kobar Club is 151 points. There is visible difference between the two test results. This can be done by comparing the Pre-test and the Post-test against T-score in the 0.05 confidence level. If T-score is greater than T-table this means there is a meaningful difference. If T-score is smaller than T-table this means there is no meaningful difference.

Normality Test

The results of the Pre-test data of L-score 0.1103 < L-table 0.258 then the Pre-test data of endurance of the arm muscles can be said to be normal, while the results of the Post-test data of L-score 0.1758 < L-table 0.258 then the Post-test data of the endurance of the arm muscles are said to be normal.

Table 4.
Normality Test

NO	Test	N	L-Score	L-Table	
1	(*Pre-test*)	10	0.1103	0.258	Normal
2	(*Post-test*)	10	0.1758	0.258	Normal

Hypothesis Test

To test the hypothesis a comparison between T-score with the present value of the distribution for the real level $\alpha = 0.05$ and the degree of freedom dk = N-1 obtained T-score = 13.07684 and T-table = 1.83311 (T-score > T-table) in this study can be understood that there is the effect of Bow Training Exercise on arm muscle endurance in the Beginner Archery Athlete Club Kobar Jambi City.

Table 5.
Hypothesis Test

NO	Test	N	S	T-Score	T-Table	
1	Tes awal (*Pre-test*)	10	3.4334	13.07684	1.83311	Accepted at the rate
2	Tes akhir (*Post-test*)	10	2.9981			95% confidence

The results of the hypothetical data of T-score 13.07684 > T-table 1.83311, so the results of the T-score when compared with the T-table can be accepted at the 95% confidence level.

Discussion

In conducting this study, researchers examined the increase in the sample of beginner archery athletes of Archery Kobar Club in Jambi. These beginner athletes have arm muscle endurance that is still lacking and below average, with treatments such as bow training exercises on the sample being increased. Bow training exercises can increase endurance of the arm muscles and require a process that is not easy because the sample must always be fit and ready when given an exercise program.

From the pre-test of arm muscle endurance the highest score obtained was 17 points, the smallest being 6 points with an average of all initial tests being 11.30 points, then at the treatment stage in the sample using bow training. After the treatment is given, then the final test is performed. At the end of the arm muscle endurance test, there is a significant difference from the post-test. The highest point was 20 while the lowest was 11 points with an average final test is 15.10 points. With thus exercise, there is a significant effect can be seen from the appendix of the table 1. The pre-test and the post-test of endurance of the arm muscles show that there is an increasing point although it doesn't increase so much because at the time of push up test, the sample did push-up but the counters only counted the correct movements.

The linkage between bow training exercises greatly affects the ability of arm muscle endurance and bow training is one of the basic archery training techniques because bow training is an exercise to form endurance of the arm muscles that is done by pulling the bow and holding the bow to a few seconds even up to several minutes. If athlete cannot hold the bow for longer, that means the arm muscle endurance of the athlete is still less and so the otherwise, if an athlete can hold the bow longer, it can be means they have a good arm muscle endurance (Nopembri et al., 2022; Nugroho et al., 2021; Yudhistira et al., 2021; Yuniana et al., 2023).

From the results of the research conducted by the research that when doing bow training little by little the sample experienced an increase in endurance of the arm muscles because when the exercises were carried out the sample they really enjoyed and were serious about doing bow training. This bow training exercise is good for improving basic archery techniques (Pratama et al., 2022; Pratama et al., 2024; Riyana et al., 2023).

From the data analysis, it turns out that the alternative

hypothesis (Ha) proposed in this study can be accepted by showing the pre-test and the post-test is different, in other words there is an increase between the pre-test and the post-test, and it can be understood that there is an Effect of Bow Training Exercises Against the Muscle Endurance Arm of Beginner Archery Club Kobar Jambi City.

Conclusion

Based on the results of the analysis of the data, after the hypothesis test, the T-Score value of 13.07684 and the T-table value of 1.83311 are obtained. Thus, it can be understood that this study has the effect of bow training exercises on the endurance of the beginner's arm archery athletes in the city of Jambi. In accordance with the results of the study and the conclusions obtained in this study, the following suggestions can be made in order to improve the endurance of arm muscles in archery by providing programmed training. It is expected that future studies will be able to use more samples and longer practice times. Henceforth, it is expected for researchers to be able to see other factors that have not been considered. For trainers or researchers who will conduct bow training exercises on arm muscle endurance the authors recommend new methods according to the conditions. For readers it is expected that by reading this thesis can teach or share to people who do not know the method of exercise to increase endurance of arm muscles.

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